Digital Phosphor Oscilloscopes

▶ DPO7000 Series

Unmatched Performance for Greater Insight Into Your Design to Get Your Work Done Faster

The DPO7000 Series are the new generation of real-time digital phosphor oscilloscopes and are the industry's best solution to the challenging signal integrity issues faced by designers verifying, characterizing, debugging and testing sophisticated electronic designs.

The family features exceptional performance in signal acquisition and analysis, operational simplicity and unmatched debugging tools to accelerate your day-to-day tasks. The largest screen in the industry and the intuitive user interface provide easy access to the maximum amount of information.

Unmatched Acquisition Performance

Signal Fidelity of Tektronix Oscilloscopes Ensures Confidence in Your Measurement Results

- High sample rate on all models, on all channels, to capture more signal details (transients, imperfections, fast edges)
  - 40 GS/s on one channel on the 2.5 GHz and 3.5 GHz models
  - Option 2SR to double the maximum real-time sample rate for the 500 MHz and 1 GHz models
- High bandwidth up to 3.5 GHz, matched across 2, 3 or 4 channels and enabled by Tektronix proprietary DSP enhancement. The user-selectable DSP filter on each channel provides magnitude and phase correction plus extension to 3.5 GHz for more accurate signal fidelity for complex measurements. The DSP filter on each channel can also be switched off to take advantage of true 2.5 GHz analog bandwidth for applications needing the highest available raw data capture
- Very low jitter noise floor and vertical accuracy for very accurate measurements
- Longest acquisition of the industry to provide more resolution and longer time sequence
  - Standard 10 million data points per channel on the DPO7000 Series
  - Optional up to 400 million total data points on 2.5 GHz and 3.5 GHz models
  - Optional up to 200 million total data points on the 500 MHz and 1 GHz models
  - Easily manage this deep record length, provide detailed comparison and analysis of multiple waveform segments with the MultiView Zoom™ feature. Automatically scroll through deep records visually or create a math expression to instantly highlight differences
- Highest performance probing solutions for differential and single-ended voltage signals as well as current measurement, because accurate design verification depends on high bandwidth access to critical signals and high-fidelity signal capture

▶ Features & Benefits

3.5 GHz Bandwidth Model for Serial and Digital Applications

2.5 GHz, 1 GHz and 500 MHz Bandwidth Models for All Applications

Up to 40 GS/s Real-time Sample Rate on One Channel and Up to 10 GS/s on All Four Channels

Up to 400 Megasamples Record Length with MultiView Zoom™ Feature for Quick Navigation

>250,000 wfm/s Maximum Waveform Capture Rate

MyScope® Custom Windows Enhance Productivity

Right Mouse Click Menus for Exceptional Efficiency

Pinpoint™ Triggering Provides the Most Flexible and Highest Performance Triggering, with Over 1400 Combinations to Address Virtually Any Triggering Situation

Small Footprint and Light Weight

12.1" Largest XGA Touch Screen Display in the Industry

Communications Mask Testing

Clock Recovery from Serial Data Streams

64 Bit NRZ Serial Pattern Trigger for Isolation of Pattern-dependent Effects Up to 1.25 Gb/s

Serial Pattern Triggering

Low-speed Serial Protocol Triggering (I^2C, SPI, RS-232, CAN)

Technology-specific Software Solutions Provide Built-in Domain Expertise for Ethernet, USB 2.0 Compliance Testing, Jitter and Timing Measurements, Power Measurements, CAN and LIN Network Design

OpenChoice® Software with Microsoft Windows XP OS Enables Built-in Networking and Extended Analysis

▶ Applications

Signal Integrity, Jitter and Timing Analysis

Verification, Debug and Characterization of Sophisticated Designs

Debugging and Compliance Testing of Serial Data Streams for Telecom and Datacom Industry Standards

Low-speed Serial Bus Design (I^2C, SPI, CAN, LIN, RS-232)

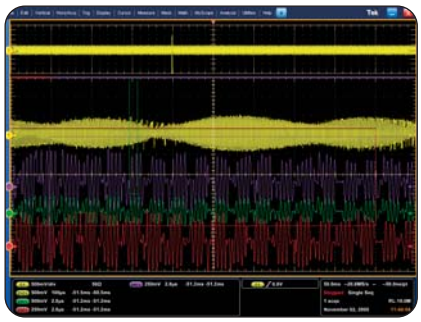
Investigation of Transient Phenomena

Power Measurements and Analysis

Spectral Analysis

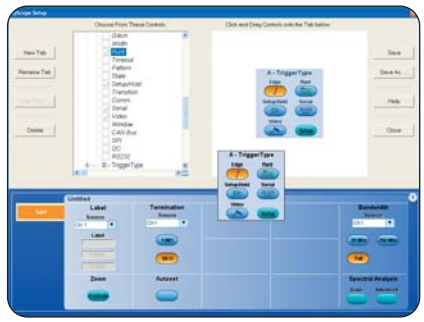
Tektronix

Enabling Innovation



▶ Zoom in on four areas of interest simultaneously to compare them.

▶ Tektronix Active probes achieve high-speed signal acquisition and measurement fidelity.



▶ Drag-and-drop menu items of interest to create the MyScope control window.

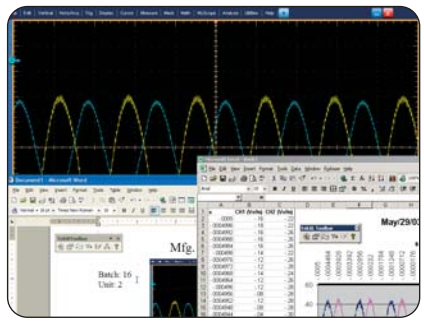
Unmatched Versatility

With the MyScope® Feature, Create Your Own Control Windows With Only the Controls, Features and Capabilities that You Care About

Easily create your own personalized "toolbox" of oscilloscope features in a matter of minutes using a simple, visual, drag-and-drop process. Once created, these custom control windows are easily accessed through a dedicated MyScope button and menu selection on the oscilloscope button/menu bar, just like any other control window. You can make an unlimited number of custom control windows, enabling each person who uses the oscilloscope in a shared environment to have their own unique control window. MyScope control windows will benefit all oscilloscope users, eliminating the ramp-up time that many face when returning to the lab after not using an oscilloscope for a while, and enables the power user to be far more efficient. Everything you need is found in one control window rather than having to constantly navigate through menu after menu to repeat similar tasks.

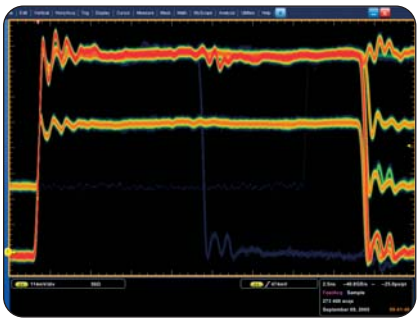
With OpenChoice® Software, Customize Your Test and Measurement System with Familiar Analysis Tools

The analysis and networking features of OpenChoice software add flexibility to Tektronix' Windows XP oscilloscopes: Using the fast embedded bus, waveform data can be moved directly from acquisition to analysis applications on the Windows desktop at much faster speeds than conventional GPIB transfers. Tektronix' implementation of industry standard protocols, such as TekVISA™ interface and ActiveX controls, are included for using and enhancing Windows applications for data analysis and documentation. IVI-COM instrument drivers are included to enable easy communication with the oscilloscope using GPIB, serial data and LAN connections from programs running on the instrument or an external PC. Or, use the Software Developer's Kit (SDK) to help create custom software to automate multi-step processes in waveform collection and analysis with Visual BASIC, C, C++, MATLAB, LabVIEW, LabWindows/CVI

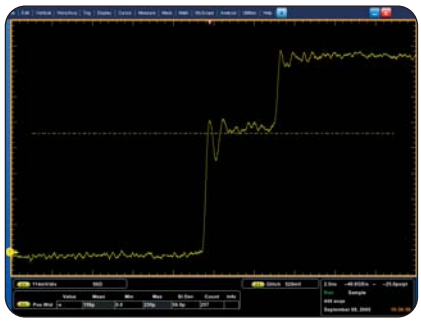


▶ Capture data into Microsoft Excel using the unique Excel toolbar, and create custom reports using the Word toolbar.

and other common Application Development Environments (ADE). Integration of the oscilloscope with external PCs and non-Windows hosts is also supported by the DPO7000 Series software solutions. In addition, the OpenChoice architecture provides a comprehensive software infrastructure for faster, more versatile operations. Data transfer programs, such as the Excel or Word toolbar, are used to simplify analysis and documentation on the Windows desktop or on an external PC.



▶ Maximize the probability of capturing elusive glitches and other infrequent events with FastAcq acquisition mode.



▶ Isolate glitches down to 200 ps wide.

▶ Isolate set-up and hold violations down to 360 ps.

Accelerate the Debug of Complex Electrical Designs

FastAcq Acquisition Mode Expedites Debugging by Clearly Showing Imperfections

More than just color-grading, FastAcq enabled by Tektronix proprietary DPX® acquisition technology, captures signals up to more than 250,000 waveforms per second on all 4 channels simultaneously, dramatically increasing the probability of discovering infrequent fault events. And with a simple turn of the intensity knob you can clearly see "a world others don't see," because frequency of occurrence is color-coded. Some oscilloscope vendors claim high waveform capture rates for short bursts of time, but only the DPO7000 Series, enabled by DPX technology, can deliver these fast waveform capture rates on a sustained basis – saving minutes, hours or even days by quickly revealing the nature of faults so sophisticated trigger modes can be applied to isolate them.

The Ability to Trigger an Oscilloscope on Events of Interest is Paramount in Complex Signal Debug and Validation

Whether you're trying to find a system error or need to isolate a section of a complex signal for further analysis, Tektronix' Pinpoint™ triggering provides the solution. The Pinpoint trigger system uses Silicon Germanium (SiGe) technology to provide trigger sensitivity of up to the bandwidth of the instrument, and allows selection of most trigger types on both A and B trigger circuits. It can capture very narrow glitches with very little trigger jitter. Other trigger systems offer multiple trigger types only on a single event (A event), with delayed trigger (B event) selection limited to edge type triggering and often do not provide a way to reset the trigger sequence if the B event doesn't occur. But Pinpoint triggering provides a full suite of advance trigger types on both A and B triggers with Reset triggering to begin the trigger sequence again after a specified time, state or transition so that even events in the most complex signals can be captured. Other oscilloscopes typically offer less than 20 trigger combinations; Pinpoint triggering offers over 1400 combinations, all at full performance.

Now you can even use a probe and the full functionality of the trigger system with the Auxiliary trigger input.

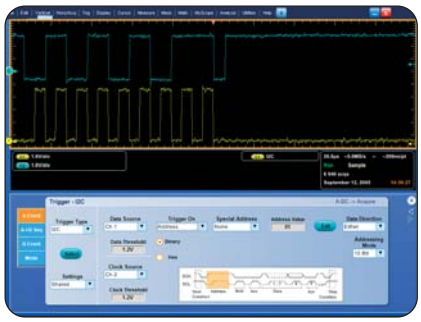
Trigger on the Most Relevant Bit Sequence of the Industry Standard Serial Bus

I^2C (Inter-Integrated Circuit) triggering is a standard feature and includes Start condition, Missing Acknowledge, Restart, Data Read, Address and/or Data Frame, in a 10 bit or 7 bit format.

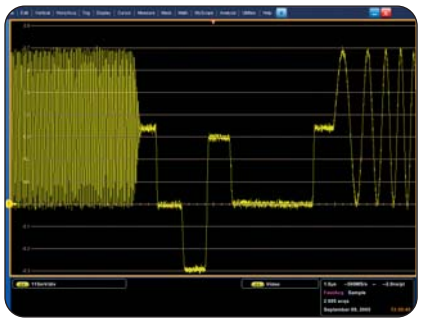
SPI (Serial Peripheral Interface) triggering is a standard feature and includes triggering on a data pattern within a user-definable frame.

RS-232 triggering is a standard feature.

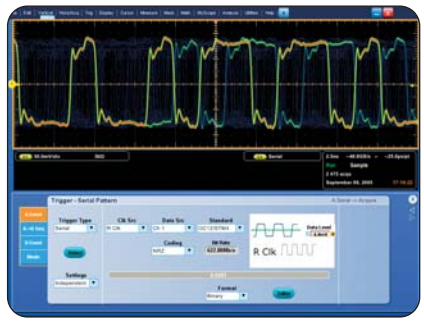
CAN (Controller Area Network) triggering is an optional feature (Opt. LSA) and includes synchronization to the Start or End of a CAN frame on any CAN high or CAN low signal, triggering on Type of Frame (Data, Remote, Overload), Identifier, Data, Missing Acknowledge and Bit Stuffing error.



▶ Easily trigger on a specific I²C address.



▶ Triggering on an analog HDTV tri-level sync signal and examining horizontal blanking interval.



▶ Serial pattern triggering to debug pattern dependent issues.

Analog HDTV/EDTV triggering for emerging standards like 1080i, 1080p, 720p and 480p as well as standard video triggering on any line within a field, all lines, all fields, odd or even fields for NTSC, SECAM and PAL video signals. In addition, IRE and mV graticules can be selected for easier measurements and visual inspection. This is a standard feature.

To debug serial architectures, use the serial pattern triggering option for NRZ serial data stream with built-in clock recovery (available on models DPO7254 and DPO7354 only). The instrument can recover the clock signal, identify the transitions and decode characters and other protocol data. With the combination of the Serial Trigger and Protocol Decode software, you can see the captured bit sequences decoded into their words for convenient analysis (for 8b/10b and other encoded serial data streams), or you can set the desired encoded words for the serial pattern trigger to capture. This serial trigger option covers NRZ serial standards up to 1.25 Gb/s.

Large 12.1-inch XGA Display Screen

The DPO7000 Series has the largest display in the industry with a 12.1-inch XGA touch screen that gives up to 15% more waveform display than other oscilloscope series in its class.

Ten vertical divisions give you 25% more vertical measurement resolution.

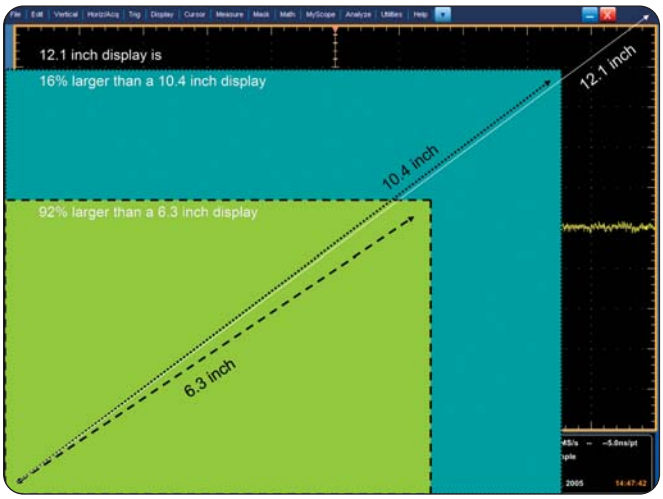
Unmatched Usability

The TekVPI™ probe interface provides versatility and ease of use enabled by intelligent bi-directional oscilloscope-to-probe communication.

The DPO7000 Series are fast-responding instruments and contain a comprehensive suite of features, such as a touch-screen, shallow menu structures, intuitive graphical icons, knob-per-channel vertical controls, support for right mouse clicks, mouse wheel improvements, saving of waveforms and measurements available in Preview mode, Export/Save/Recall menu improvements.

Interoperability with Logic Analyzers for Digital Design and Debug

Tektronix' Integrated View (iView™) data display enables digital designers to solve signal integrity challenges and effectively debug and verify their systems more quickly and easily. This integration allows designers to view time-correlated digital and analog data in the same display window, and isolate the analog characteristics of the digital signals that are causing systems failures. No user calibration is required. And, once set up, the iView feature is completely automated.



▶ How does 12.1-inch display compare to the display size of other oscilloscopes?

▶ An integrated toolset for digital design and troubleshooting.

More Insight into Your Complex Electrical Design for Characterization and Compliance Testing

Whether it's a simple math expression, waveform mask testing, a pass/fail compliance test or a custom application that you develop, the DPO7000 Series Oscilloscopes offer the industry's most comprehensive set of analysis and compliance tools.

A Wide Range of Built-in Advanced Waveform Analysis Tools

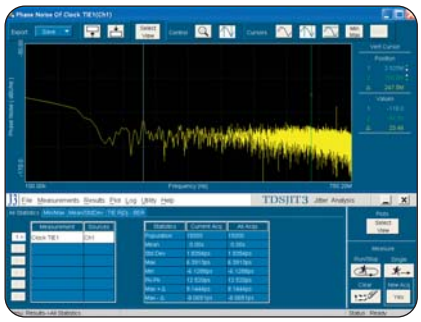
Waveform cursors make it easy to measure trace-to-trace timing characteristics, while cursors that link between YT and XY display modes make it easy to investigate phase relationships and Safe Operating Area violations. Select from 53 automatic measurements using a graphical palette that logically organizes measurements into Amplitude, Time, Combination, Histogram and Communications categories. Gather further insight into your measurement results with statistical data such as mean, min, max, standard deviation and population.

Define and apply math expressions to waveform data for on-screen results in terms that you can use. Access common waveform math functions with the touch of a button. Or, for advanced applications, create algebraic expressions consisting of live waveforms, reference waveforms, math functions, measurement values, scalars and user-adjustable variables with an easy-to-use, calculator-style editor.

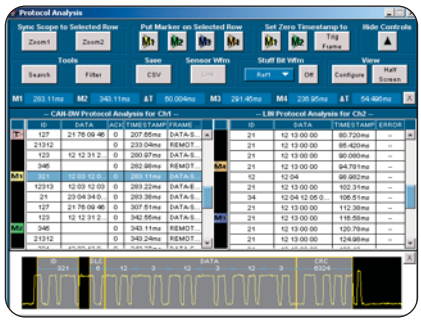
FFT – To analyze your signal in the spectral domain, use the basic spectral (provides you with the best parameter), or use the advanced spectral (to directly control the frequency span, center frequency and resolution bandwidth).

Filtering – Enhance your ability to isolate or remove some important component of your signal (noise or specific harmonics of the signal) by creating your own filters, or using the filters provided as standard with the instrument.

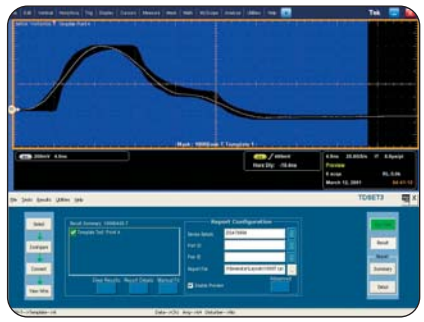
▶ Basic spectral UI control window.



▶ Jitter and Timing measurement.



▶ CAN and LIN Timing and Protocol Decode.



▶ Ethernet compliance testing.

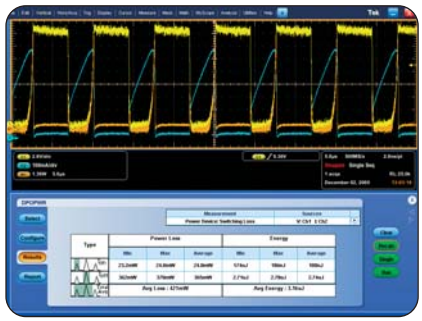
A Breadth of Optional Packages to Extend Waveform Analysis Even Further

Jitter and Timing Measurement and Analysis Package (Opt. JA3 or JE3) – Tight timing margins demand stable, low jitter designs. This software option extends the oscilloscope capability by making jitter measurements over contiguous clock cycles from every valid pulse in a single-shot acquisition. Multiple measurements and trend plots quickly show system timing under variable conditions.

This analysis package is available as Opt. JA3 or Opt. JE3 on the DPO7000 Series. JE3 provides a subset of the measurements.

Communications Mask Testing (Opt. MTM) – This feature provides a complete portfolio of masks for verifying compliance to serial communications standards. It supports 156 Standards Masks –

- ITU-T (64 Kb/s to 155 Mb/s)
- ANSI T1.102 (1.544 Mb/s to 155 Mb/s)
- Ethernet IEEE 902.3, ANSI X3.263 (125 Mb/s to 1.25 Gb/s)
- Sonet/SDH (51.84 Mb/s to 622 Mb/s)
- Fibre Channel (133 Mb/s to 2.125 Gb/s)
- USB (12 Mb/s to 480 Mb/s)
- IEEE 1394 (491.5 Mb/s to 1.966 Gb/s)
- RapidI/O (up to 2 Gb/s)
- OIF Standards (1.244 Gb/s)
- Video (143.18 Mb/s to 1.485 Gb/s)



▶ Power measurement and analysis.

▶ USB compliance testing.

CAN and LIN Timing and Protocol Decode Software (Opt. LSA) – When you need to ensure seamless and reliable operation of a CAN or LIN network, this option enables CAN bus triggering and provides the solution to measure oscillator tolerance, propagation delay and simultaneously decode CAN and LIN messages, with the protocol leveraging the trigger capabilities.

This option is offered on DPO7354, DPO7254, DPO7104 and DPO7054 as Opt. LSA.

Optional Power Measurement and Analysis (Opt. PWR) – Analyze power dissipation in power supply switching devices and magnetic components, and generate detailed reports in customizable formats. The HiRes acquisition mode delivers greater than 8 bits of vertical resolution on single-shot or repetitive signals at bandwidth up to 125 MHz. The powerful and flexible measurements, math and math-on-math capabilities make it an ideal solution for performing power measurements, such as voltage, current, instantaneous power and energy, for power device designers. The new TekVPI™ interface provides smart communication between the oscilloscope and the probe. TekVPI probe interface also provides more power to the probe interface, allowing customers to directly connect current probes to the front of the oscilloscope.

Optional Ethernet (Opt. ET3) – Provides compliance testing for 10/100/1000Base-T signals.

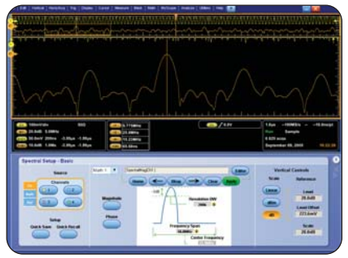
Optional USB (Opt. USB) – Provides compliance testing for USB2.0 signals.

▸ Characteristics

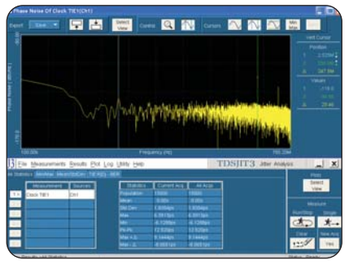
▸ Vertical System

	DPO7054	DPO7104	DPO7254	DPO7354
Input Channels	4			
Bandwidth (DSP Bandwidth Enhance)	N/A	N/A	N/A	3.5 GHz[*1]
Rise Time (DSP Bandwidth Enhance)				115 ps
Hardware Analog Bandwidth (–3 dB)	500 MHz	1 GHz	2.5 GHz	2.5 GHz
Rise Time 10% to 90% (typical)	460 ps	300 ps	160 ps	145 ps
Rise Time 20% to 80% (typical)	310 ps	200 ps	100 ps	95 ps
DC Gain Accuracy	±1% with offset/position set to 0			
Hardware Bandwidth Limits	250 MHz or 20 MHz			
Input Coupling	AC, DC, GND			
Input Impedance (software selectable)	1 MΩ ±1% with 13 pF ±2 pF or 50 Ω ± 1%			
Input Sensitivity	1 MΩ: 1 mV/div to 10 V/div 50 Ω: 1 mV/div to 1 V/div			
Vertical Resolution	8 bit (>11 bit with averaging)			
Max Input Voltage, 1 MΩ	±150 V CAT I, derate at 20 dB/decade to 9 V_{RMS} above 200 kHz			
Max Input Voltage, 50 Ω	5 V_{RMS}, with peaks less than ±24 V			
Position Range	±5 divisions			
Offset Range	1 mV/div to 50 mV/div: ±1 V 50.5 mV/div to 99.5 mV/div: ±0.5 V 100 mV/div to 500 mV/div: ±10 V 505 mV/div to 995 mV/div: ±5 V 1 V/div to 5 V/div: ±100 V 5.05 V/div to 10 V/div: ±50 V			
Offset Accuracy	1 mV/div to 9.95 mV/div: ±0.2% (offset value-position) ±0.1 div ±1.5 mV 10 mV/div to 99.5 mV/div: ±0.35% (offset value-position) ±0.1 div ±1.5 mV 100 mV/div to 1 V/div: ±0.35% (offset value-position) ±0.1 div ±15 mV 1.01 V/div to 10 V/div: ±0.25% (offset value-position) ±0.1 div ±150 mV			
Delay between any two channels (typical)	≤100 ps (50 Ω, DC coupling and equal V/div at or above 10 mV/div)			
Channel-to-Channel Isolation (any two channels at equal vertical scale settings) (typical)	≥100:1 at ≤100 MHz; ≥30:1 between 100 MHz and 2.5 GHz > 20:1 between 2.5 and 3.5 GHz			

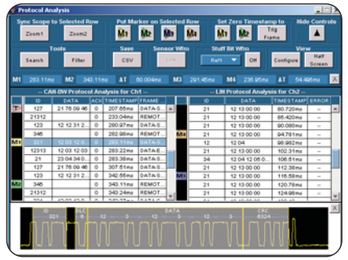
[*1] 3 GHz for sinewave of more than 4 div amplitude (typically).



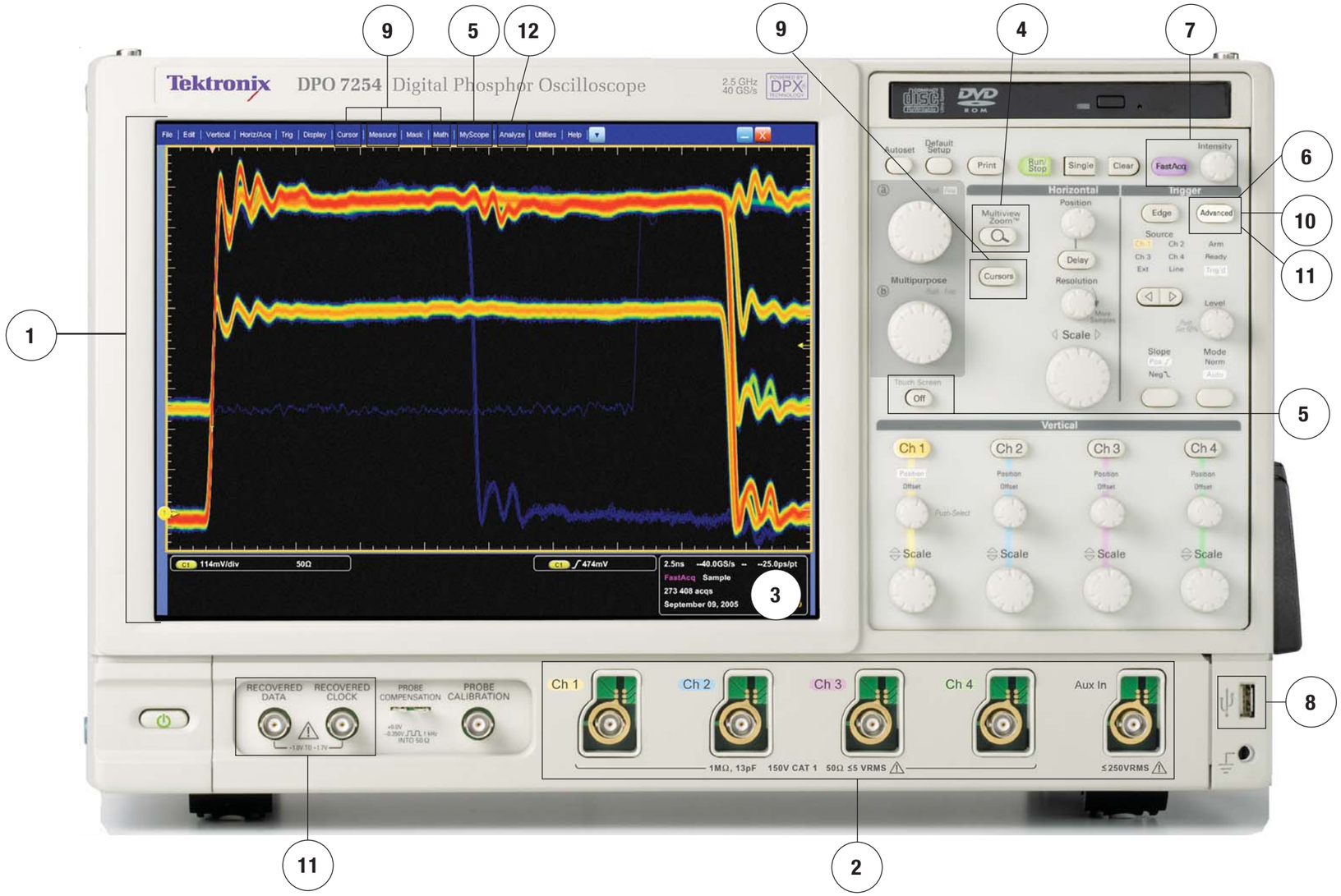
► Basic spectral UI control window.

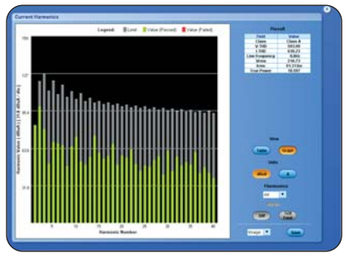


► Jitter and Timing Measurement.

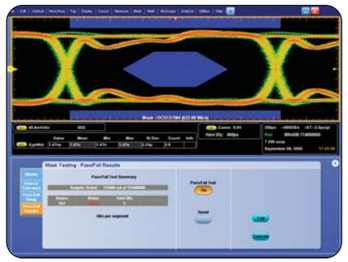


► CAN and LIN Timing and Protocol Decode.

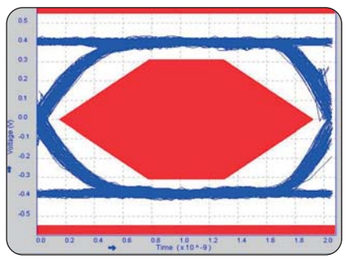




► Power measurement.



► Testing a 622 Mb/s signal against the mask specified by the standard.



► USB compliance testing.

1 Large 12.1-inch XGA Touch Screen Display

The DPO7000 series touch screen gives up to 15% more waveform display than other oscilloscopes of its class.

2 New Probe Interface

TekVPI™ probe interface provides versatility and ease of use enabled by intelligent bi-directional oscilloscope-to-probe communication.

3 Exceptional Performance

The performance of the highest bandwidth oscilloscope in a mid-range offering with up to 40 GS/s real-time sample rate and 400 M record length on one channel.

4 With MultiView Zoom™

Easily deep into very long record of acquired data, analyze multiple waveform segments simultaneously and scroll automatically through the deepest records visually.

5 Unmatched Usability

With MyScope®, create your own control window with only the controls you care about. The versatile user interface allows you to use the touch screen or the mouse.

6 Accelerate the Debug of Complex Designs with Pinpoint™ Triggering

Access up to 1400 trigger combinations to address virtually any triggering situations.

7 FastAcq Acquisition Expedites Debugging by Clearly Showing Faults

More than 250,000 waveforms per second, and with a simple turn of the intensity knob, clearly see the frequency of occurrence.

8 Easy Connectivity

Built-in USB port at the front, to ease the saving of your work.

Most standard input/output ports available on the side of the instrument.

9 A Wide Range of Built-in Advanced Analysis Tools

Cursors that link between XY and YT.

53 automatic measurements.

Many math functions, common and more advanced (like FFT and Spectral).

10 For Insight into Your Low-speed Serial Designs

Serial Protocol Triggering for I^2C, SPI, CAN plus a complete CAN and LIN timing and protocol analysis software package.

11 For Insight into Your High-speed Serial Designs

Optional NRZ Serial Pattern triggering plus Recovered Clock and Recovered Data available on the front of the DPO7254 or the DPO7354 instruments.

12 A Breadth of Optional Software Packages for Expanded Waveform Analysis

▸ Time Base System

	DPO7054	DPO7104	DPO7254 / DPO7354
Time Base Range	100 ps/div to 1000 s/div	50 ps/div to 1000 s/div	25 ps/div to 1000 s/div
with Opt. 2SR	50 ps/div to 1000 s/div	25 ps/div to 1000 s/div	—
Time Resolution (in ET/IT mode)	1 ps	500 fs	250 fs
with Opt. 2SR	500 fs	250 fs	—
Time Base Delay Time Range	5 ns to 250 s		
Channel-to-Channel Deskew	Range ±75 ns		
Delta Time Measurement Accuracy	((0.06/sample rate) + (2.5 ppm x Reading)) RMS		
Trigger Jitter (RMS)	1.5 ps $_{RMS}$ (typical)		
Jitter Noise Floor	<1 ps $_{RMS}$ (<2 ps peak) for record duration <10 µs (typical) <2.5 ps$_{RMS}$ for record duration <30 ms <65 parts/trillion for record durations <10 s		
Time Base Accuracy	±2.5 ppm + Aging <1 ppm per year		

▸ Acquisition System

	DPO7054	DPO7104	DPO7254/DPO7354
Real-time Sample Rates			
1 Channel (max)	10 GS/s	20 GS/s	40 GS/s
With Opt. 2SR	20 GS/s	40 GS/s	—
2 Channels (max)	5 GS/s	10 GS/s	20 GS/s
With Opt. 2SR	10 GS/s	20 GS/s	—
3 to 4 Channels (max)	2.5 GS/s	5 GS/s	10 GS/s
With Opt. 2SR	5 GS/s	10 GS/s	—
Equivalent Time Sample Rate (max)	4 TS/s (for repetitive signals)		
Maximum Record Length per Channel			
With Standard Configuration	40 M (1-CH.), 20 M (2-CH.), 10 M (4-CH.)		
With Record Length Opt. 2RL	80 M (1-CH.), 40 M (2-CH.), 20 M (4-CH.)		
With Record Length Opt. 5RL	200 M (1-CH.), 100 M (2-CH.), 50 M (4-CH.)		
With Record Length Opt. 10RL	—	—	400 M (1-CH.) 200 M (2-CH.) 100 M (4-CH.)

▸ Maximum Duration at Highest Real-time Resolution (1-CH)

	DPO7054	DPO7104	DPO7254 / DPO7354
Resolution	100 ps (10 GS/s)	50 ps (20 GS/s)	25 ps (40 GS/s)
With Opt. 2SR	50 ps (20 GS/s)	25 ps (40 GS/s)	—
Max Duration with Standard Record Length and Sample Rate	4 ms	2 ms	1 ms
With Opt. 2SR	2 ms	1 ms	—
Max Duration with Opt. 2RL	8 ms	4 ms	2 ms
With Opt. 2SR	4 ms	2 ms	—
Max Duration with Opt. 5RL	20 ms	10 ms	5 ms
With Opt. 2SR	10 ms	5 ms	—
Max Duration with Opt. 10RL	—	—	10 ms

▸ Acquisition Modes

	DPO7054/DPO7104/DPO7254/DPO7354
FastAcq Acquisition Mode	FastAcq optimizes the instrument for analysis of dynamic signals and capture of infrequent events
Maximum FastAcq Waveform Capture Rate	>250,000 wfm/s on all 4 channels simultaneously
Waveform Database	Accumulate waveform database providing three-dimensional array of amplitude, time and counts
Sample	Acquire sampled values
Peak Detect	Captures narrow glitches at all real-time sampling rates: 1 ns at ≤125 MS/s; 1/sample rate at ≥250 MS/s
Averaging	From 2 to 10,000 waveforms included in average
Envelope	From 1 to 2 x 10^9 waveforms included in min-max envelope
Hi-Res	Real-time boxcar averaging reduces random noise and increases resolution
FastFrame™ Acquisition	Acquisition memory divided into segments; maximum trigger rate >310,000 waveforms per second. Time of arrival recorded with each event
Roll Mode	Up to 10 MS/s with a maximum record length of 40 M

▸ Pinpoint™ Trigger System

	DPO7054/DPO7104/DPO7254/DPO7354
Sensitivity	
Internal DC Coupled	0.7 div DC to 50 MHz increasing to 1.2 div at rated analog bandwidth (typical); 2.5 div at 3.5 GHz with DSP Bandwidth enhance
External (auxiliary input) 1 MΩ	250 mV from DC to 50 MHz increasing to 350 mV at 250 MHz (typical)
Trigger Characteristics	
A Event and Delayed B Event Trigger Types	Edge, Glitch, Runt, Width, Transition Time, Timeout, Pattern, State, Setup/Hold, Window – all except Edge, Pattern and State can be Logic State qualified by up to two channels
Low Speed Serial Protocol Trigger Type (A Event only)	I^2C, SPI and RS-232 (standard). CANbus available as Opt. LSA. Trigger on address, data and special handshaking states and other conditions
Main Trigger Modes	Auto, Normal and Single
Trigger Sequences	Main, Delayed by Time, Delayed by Events, Reset by Time, Reset by State, Reset by Transition. All sequences can include separate horizontal delay after the trigger event to position the acquisition window in time
Communications-related Triggers	Requires Opt. MTM. Support for AMI, HDB3, BnZS, CMI, MLT3 and NRZ encoded communications signals. Select among isolated positive or negative one, zero pulse form or eye patterns as applicable to the standard
Serial Pattern Trigger	On DPO7254 or DPO7354 only, and requires Opt. PTM. Up to 64 bit serial word recognizer, bits specified in binary (high, low, don't care) or hex format. Trigger on NRZ-encoded data up to 1.25 Gb/s
Video Type Trigger Formats and Field Rates	Triggers from negative sync composite video, field 1 or field 2 for interlaced systems, any field, specific line, or any line for interlaced or non-interlaced systems. Supported systems include NTSC, PAL, SECAM and HDTV 1080/24sF, 1080p/25, 1080i/50, 1080i/60, 1080p/24, 720p/60, 480p/60
Clock Recovery System	On DPO7254 or DPO7354 only and requires Opt. PTM or MTM
Clock Recovery Phase Locked Loop Bandwidth	Fixed at FBaud/500
Frequency Range	1.5 MBaud to 1.25 GBaud
Clock Recovery Jitter (RMS)	<0.25% bit period + 5 ps_{RMS} for PRBS data patterns <0.25% bit period + 5 ps_{RMS} for repeating "0011" data pattern (typical)
Tracking/Acquisition Range	±5% of requested baud (typical)
Minimum Signal Amplitude needed for Clock Recovery	1 div_{pk-pk} up to 1.25 GBaud (typical)
Trigger Level Range	
Internal	±12 divisions from center of screen
AUX Trigger	TekVPI interface; ±5 V (50 Ω); 150 V CAT I, derate at 20 dB/decade to 9 V_{RMS} above 200 KHz (1 MΩ)
Line	Fixed at 0 V
Trigger Coupling	DC, AC (attenuates <60 Hz), HF Rej (attenuates >30 kHz), LF Rej (attenuates <80 kHz), Noise Reject (reduces sensitivity)
Trigger Holdoff Range	250 ns min to 12 s max

Trigger Modes

Edge – Positive or negative slope on any channel or front panel auxiliary input. Coupling includes DC, AC, noise reject, HF reject and LF reject.
Glitch – Trigger on or reject glitches of positive, negative or either polarity. Minimum glitch width is down to 170 ps (typical) with re-arm time of 250 ps (for DPO7254 or DPO7354).
Width – Trigger on width of positive or negative pulse either within or out of selectable time limits (down to 225 ps).
Runt – Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again. Event can be time- or logic-qualified.
Timeout – Trigger on an event which remains high, low or either, for a specified time period. Selectable from 300 ps.
Transition – Trigger on pulse edge rates that are faster or slower than specified. Slope may be positive, negative or either.
Setup/Hold – Trigger on violations of both setup time and hold time between clock and data present on any two input channels.
Pattern – Trigger when pattern goes false or stays true for specified period of time. Pattern (AND, OR, NAND, NOR) specified for four input channels defined as high, low or don't care.
State – Any logical pattern of channels (1, 2, 3) clocked by edge on channel 4. Trigger on rising or falling clock edge.
Window – Trigger on an event that enters or exits a window defined by two user-adjustable thresholds. Event can be time- or logic-qualified.
Trigger Delay by Time – 5 ns to 250 s.
Trigger Delay by Events – 1 to 10,000,000 events.
Comm – Provided as part of Opt. MTM. Support for AMI, HDB3, BnZS, CMI, MLT3 and NRZ encoded signals.
I^2C, SPI and RS-232 – Protocol trigger on DPO7054, DPO7154, DPO7254 or DPO7354.
CAN – Protocol trigger on DPO7054, DPO7154, DPO7254 or DPO7354 as part of Opt. LSA.
Serial Pattern – Captures serial data stream with built-in clock recovery for NRZ standards up to 1.25 Gb/s. Opt. ST.

Waveform Measurements

Automatic Measurements – 53, of which 8 can be displayed on screen at any one time; measurement statistics, user-definable reference levels, measurement within gates isolating the specific occurrence within an acquisition to take measurements on.
Amplitude Related – Amplitude, High, Low, Maximum, Minimum, Peak-to-Peak, Mean, Cycle Mean, RMS, Cycle RMS, Positive Overshoot, Negative Overshoot.
Time Related – Rise Time, Fall Time, Positive Width, Negative Width, Positive Duty Cycle, Negative Duty Cycle, Period, Frequency, Delay.
Combination – Area, Cycle Area, Phase, Burst Width.
Histogram Related – Waveform Count, Hits in Box, Peak Hits, Median, Maximum, Minimum, Peak to Peak, Mean (μ), Standard Deviation (σ), μ+1σ, μ+2σ, μ+3σ.
Eye Pattern Related – Extinction Ratio (absolute, %, dB), Eye Height, Eye Width, Eye Top, Eye Base, Crossing %, Jitter (pk-pk, RMS, 6σ), Noise (pk-pk, RMS), Signal/Noise Ratio, Cycle Distortion, Q-Factor.

Waveform Processing/Math

Arithmetic – Add, Subtract, Multiply, Divide Waveforms and Scalars.
Algebraic Expressions – Define extensive algebraic expressions including Waveforms, Scalars, User-adjustable Variables and Results of Parametric Measurements, e.g., (Integral (CH.1–Mean(CH.1)) x 1.414 x VAR1).
Math Functions – Average, Invert, Integrate, Differentiate, Square Root, Exponential, Log_{10}, Log_e, Abs, Ceiling, Floor, Min, Max, Sin, Cos, Tan, ASin, ACos, ATan, Sinh, Cosh, Tanh.
Relational –
Boolean result of comparison >, <, ≥, ≤, =, ≠.
Frequency Domain Functions – Spectral Magnitude and Phase, Real and Imaginary Spectra.
Vertical Units –
Magnitude: Linear, dB, dBm.
Phase: Degrees, radians, group delay.
IRE and mV units.
Window Functions – Rectangular, Hamming, Hanning, Kaiser-Bessel, Blackman-Harris, Gaussian, Flattop2, Tek Exponential.
Waveform Definition – As an arbitrary math expression.
Filtering Functions – User-definable filters. Users specify a filter containing the coefficients of the filter. Filter files provided.
Mask Function – A function that generates a Waveform Database pixmap from a sample waveform. Sample count can be defined.

Display Characteristics

Display Type – Liquid crystal active-matrix color display.
Display Size – Diagonal: 307.3 mm (12.1 in.).
Display Resolution – XGA 1240 horizontal x 768 vertical pixels.
Waveform Styles – Vectors, Dots, Variable Persistence, Infinite Persistence.
Color Palettes – Normal, Green, Gray, Temperature, Spectral and User-defined.
Display Format – YT, XY

Computer System and Peripherals

Operating System – Windows XP.
CPU – Intel Pentium 4, 3.4 GHz processor.
PC System Memory – 2 GB.
Hard Disk Drive – Rear-panel, removable hard disk drive, 80 GB capacity.
CD-R/W Drive – Front-panel CD-R/W drive with CD creation software application.
DVD Drive – Read only.
Mouse – Optical wheel mouse, USB interface.
Printer (optional) – Thermal printer; fits in accessories pouch provided with instrument.
Keyboard – Order 119-7083-00 for small keyboard (fits in pouch); USB interface and hub.

Input/Output Ports

Front Panel

Probe Compensator Output – Front panel pins. Amplitude 1 V ±20% into a ≥50 Ω load; 500 mV from base to top into a 50 Ω load, frequency 1 kHz ±5%.
Recovered Clock (for DPO7254 or DPO7354 only) – BNC connector, ≤1.25 Gb/s, Output swing≥130 mV_{pk-pk} into 50 Ω. Requires option to enable.
Recovered Data (for DPO7254 or DPO7354 only) – BNC connector , ≤1.25 Gb/s, Output swing 200 mV into 50 Ω. Requires option to enable.
USB 2.0 Port – One USB 2.0 connector.
Aux Trigger Input – See Trigger specification.

Side Panel

Parallel Port – IEEE 1284, DB-25 connector.
Audio Ports – Miniature phone jacks (disabled).
Keyboard Port – PS-2 compatible.
Mouse Port – PS-2 compatible.
USB Ports – Four USB 2.0 connectors.
LAN Port –
RJ-45 connector, supports 10Base-T, 100Base-T and Gigabit Ethernet.
Serial Port – DB-9 COM1 port.
VGA Video Port –
DB-15 female connector; connect a second monitor to use dual-monitor display mode. Supports basic requirements of PC99 specifications.
Oscilloscope VGA Video Port –
DB-15 female connector, 31.6 kHz sync, EIA RS-343A compliant, connect to show the oscilloscope display, including live waveforms on an external monitor or projector.

Rear Panel

Power –
100 to 240 V_{RMS} ± 10%, 47 to 63 Hz, <550 W
115 V_{RMS} ± 10%, 400 Hz, CAT I, <500 VA.
Analog Signal Output –
BNC connector provides a buffered version of the signal that is attached to the Ch 3 input
Amplitude: 50 mV/div ±20% into a 1 MΩ load, 25 mV/div ±20% into a 50 Ω load
Bandwidth: 100 MHz into a 50 Ω load
Software-Switchable BNC Connector –
External Time Base Reference In: BNC connector, time base system can phase-lock to external 10 MHz reference.
Time Base Reference Out: BNC connector, provides TTL-compatible output of internal 10 MHz reference oscillator.
Aux Trigger Output –
BNC connector provides a TTL-compatible, polarity switchable pulse when the oscilloscope triggers.
GPIB Port – IEEE 488.2 standard.

Physical Characteristics

Benchtop Configuration

Dimensions	mm	in.
Height	292	11.48
Width	451	17.75
Depth	265	10.44
Weight	kg	lbs.
Net	15	32
Shipping	28.9	63.75

Rackmount Configuration

Dimensions	mm	in.
Height	323	12.25
Width	479	18.85
Depth (from rack-mounting ear to back of instrument)	231.75	9.12
Weight	**kg**	**lbs.**
Net	17.4	37.5
Rackmount Kit	2.5	5.5

Mechanical

Cooling — Required Clearance

	mm	in.
Top	0	0
Bottom	0	0
Left side	76	3
Right Side	0	0
Front	0	0
Rear	0	0

Environmental

Temperature

Operating –
0 ºC to +50 ºC, excluding CD-R/W drive;
+10 ºC to +45 ºC, including CD-R/W drive.
Non-operating – –40 ºC to +71 ºC.

Humidity

Operating –
5% to 95% relative humidity (RH) with a maximum wet bulb temperature of +29 ºC at or below +50 ºC, non-condensing. Upper limit derated to 45% RH above +30 ºC up to +50 ºC.
Non-operating –
5% to 95% relative humidity (RH) with a maximum wet bulb temperature of +29 ºC at or below +60 ºC, non-condensing. Upper limit derated to 45% RH above +30 ºC up to +50 ºC.

Altitude

Operating – 10,000 ft. (3,048 m).
Non-operating – 40,000 ft. (12,190 m).

Random Vibration

Operating –
0.000125 G^2/Hz from 5 to 350 Hz, –3 dB/octave from 350 to 500 Hz, 0.0000876 G^2/Hz at 500 Hz. Overall level of 0.27 G_{RMS}.
Non-operating –
0.0175 G^2/Hz from 5 to 100 Hz, –3 dB/octave from 100 to 200 Hz, 0.00875 G^2/Hz from 200 to 350 Hz, –3 dB/octave from 350 to 500 Hz, 0.006132 G^2/Hz at 500 Hz. Overall level of 2.28 G_{RMS}.

Regulatory

Electromagnetic Compatibility –
93/68/EEC; EN61326:1997 +A1 1998+A2:2000.
Certifications –
UL 3111-1, CSA1010.1, ISO11469, EN61010-1, IEC 61010-1.

▸ Ordering Information

DPO7054

500 MHz Digital Phosphor Oscilloscope.

DPO7104

1 GHz Digital Phosphor Oscilloscope.

DPO7254

2.5 GHz Digital Phosphor Oscilloscope.

DPO7354

3.5 GHz Digital Phosphor Oscilloscope for Serial and Digital applications.

All Models Include: Accessory pouch, front cover, mouse, quick start user manual (071-173x-xx), probe calibration and deskew fixture (067-0405-xx), DPO7000 Series product software media, DPO7000 Series operating system restoration media, optional applications software media, performance verification procedure PDF file, GPIB programmer's reference (on product software media), calibration certificate documenting NIST traceability, Z 540-1 compliance and ISO9001, power cord, one year warranty. User to specify quick start user manual language, and power plug when ordering. DPO7054 also includes: (4) P6139A 500 MHz, 10x passive probes. (Probes and accessories are not included in the oscilloscope warranty. Refer to the data sheet for each probe for its unique warranty and calibration terms.)

Options

▸ Instrument Options

Record Length Options	
Opt. 2RL	80 MSamples max, 20 MSamples/ch
Opt. 5RL	200 MSamples max, 50 MSamples/ch
Opt. 10RL (for DPO7254/DPO7354 only)*2	400 MSamples max, 100 MSamples/ch
Hardware Options	
Opt. 2SR*3 – Double maximum real-time sample rate DPO7104: 40 GS/s (1 channel), 20 GS/s (2 channels), 10 GS/s (3 or 4 channels) DPO7054: 20 GS/s (1 channel), 10 GS/s (2 channels), 5 GS/s (3 or 4 channels)	Available for DPO7104/DPO7054 only
Opt. 1P – Thermal printer in the pouch.	Printer option is available for all models
Software Options	
Opt. LSA	Low Speed Serial Analysis includes CAN/LIN Trigger, Decode and Analysis
Opt. MTM	Mask Testing for Serial Communication Standards (up to 1.5 Gb/s). Includes hardware clock recovery on DPO7254/DPO7354
Opt. PTM (for DPO7254/DPO7354 only)*2	8b/10b protocol triggering and NRZ serial pattern triggering. Includes hardware clock recovery up to 1.5 Gb/s
Opt. JA3	TDSJIT3 Advanced Jitter Analysis Software
Opt. JE3	TDSJIT3 Essentials Jitter Analysis Software
Opt. ET3*4	TDSET3 Ethernet Compliance Test Software
Opt. USB*5	TDSUSBS USB2.0 Compliance Test Software only
Opt. PWR	DPOPWR Power Measurement and Analysis Software
Opt. RTE (for DPO7254/7354 only)*2	RT-Eye® Serial data compliance and analysis software
Opt. DVI (for DPO7354 only)*6	Digital Visual Interface compliance test software
Bundle Options	
Opt. PS1	Power Bundle option includes TPA, BNC adapter, Probe Calibration and deskew fixture 067-1686-xx, P5205, TCP0030 and Opt. PWR

User Manual Options

Opt. L0 – English manual.

Opt. L1 – French manual.

Opt. L3 – German manual.

Opt. L5 – Japanese manual.

Opt. L7 – Simplified Chinese manual.

Opt. L8 – Standard Chinese manual.

Opt. L9 – Korean manual.

Opt. L10 – Russian manual.

Power Plug Options

Opt. A0 – North America.

Opt. A1 – Universal European Union.

Opt. A2 – UK.

Opt. A3 – Australia.

Opt. A5 – Switzerland.

Opt. A6 – Japan.

Opt. A10 – China.

Opt. A11 – India.

Opt. A99 – No power cord.

Service Options

(Probes and accessories are not included in the oscilloscope warranty. Refer to the data sheet for each probe for its unique warranty and calibration terms.)

Opt. C3 – Calibration Service 3 years.

Opt. C5 – Calibration Service 5 years.

Opt. D1 – Calibration Data Report.

Opt. D3 – Calibration Data Report 3 years (with Opt. C3).

Opt. D5 – Calibration Data Report 5 years (with Opt. C5).

Opt. R3 – Repair Service 3 years.

Opt. R5 – Repair Service 5 years.

Recommended Accessories

Probes

TCP202[*7] – DC coupled current probe.

TDP0500 – 500 MHz TekVPI™ high voltage differential probe.

TDP1000 – 1 GHz TekVPI high voltage differential probe.

TAP3500 – 3.5 GHz TekVPI active single-ended probe.

TAP2500 – 2.5 GHz TekVPI active single-ended probe.

TAP1500 – 1.5 GHz TekVPI active single-ended probe.

TCP0030 – >120 MHz TekVPI AC/DC 30 A current probe.

TPA-BNC – TekProbe-BNC Level 2 to TekVPI adapter.

P6139A – 500 MHz, passive probe.

P6158 – 3 GHz, 20x low C probe.

P6247[*7] – 1 GHz differential probe.

P6243[*7] – 1 GHz active probe.

P6245[*7] – 1.5 GHz active probe.

P6248[*7] – 1.5 GHz differential probe.

P6330[*7] – 3 GHz differential probe.

P6246[*7] – 400 MHz differential probe.

P6101B – 1x passive probe 15 MHz.

TCPA300/TCPA400[*7] – Series current measurement systems.

P5200/P5205/P5210[*7] – High voltage differential probes.

P5100/P6015A – High voltage probes.

Cables

GPIB Cable (1 m) – Order 012-0991-01.

GPIB Cable (2 m) – Order 012-0991-00.

RS-232 Cable – Order 012-1298-00.

Centronics Cable – Order 012-1214-00.

Accessories

Mini Keyboard (USB interface) – Order 119-7083-00.

Keyboard (USB interface) – Full-size keyboard with 4-port USB hub. Order 119-6297-00.

Service Manual – Order 071-1740-xx.

Transit Case – Order 016-1942-00.

Transit Case with Wheels – Order 016-1522-00.

Video Display Clamp Order – Order 013-0278-xx.

Rackmount Kit – Order 016-1985-xx.

Oscilloscope Cart – Order K420 (requires 407-5192-00 bracket set).

Thermal Printer Paper– Order 016-1969-00.

Test Fixtures

TDSUSBF – Test fixture for use with Opt. USB.

Probe Calibration/Power Deskew Fixture – Order 067-1686-00.

Ethernet Test Fixture – Order through Crescent Heart Software (http://www.c-h-s.com).

Adapters

AMT75 – 1 GHz 75 Ω adapter.

P6701B[*7] – Optical/electrical converter (multi-mode).

P6703B[*7] – Optical/electrical converter (single-mode).

Instrument Upgrades

To upgrade your DPO7000 Series Oscilloscope, order option as noted:

DPO7UP with Opt. RL02 – To upgrade record length from standard configuration to Opt. 2RL configuration.

RL05 – To upgrade record length from standard configuration to Opt. 5RL configuration.

RL010[*2] – To upgrade record length on DPO7254 or DPO7354 from standard configuration to Opt. 10RL configuration.

RL25 – To upgrade record length from Opt. 2RL configuration to Opt. 5RL configuration.

RL210[*2] – To upgrade record length on DPO7254 or DPO7354 from Opt. 2RL configuration to Opt. 10RL configuration.

RL510[*2] – To upgrade record length on DPO7254 or DPO7354 from Opt. 5RL configuration to Opt. 10RL configuration.

DVI[*6] – To upgrade DPO7000 Series with Opt. DVI.

RTE[*2] – To upgrade DPO7000 Series with Opt. RTE or TDSRT-Eye software.

LSA – To upgrade DPO7000 Series with Opt. LSA.

JE3 – To upgrade DPO7000 Series with Opt. JE3.

ET3[*4] – To upgrade DPO7000 Series with Opt. ET3.

JA3 – To upgrade DPO7000 Series with Opt. JA3.

USB[*5] – To upgrade DPO7000 Series with Opt. USB.

MTM – To upgrade DPO7000 Series with Opt. MTM.

PTM[*2] – To upgrade DPO7254 or DPO7354 with Opt. PTM.

PWR – To upgrade DPO7000 Series with Opt. PWR.

CP2[*8] – TDSCPM2 ANSI/ITU Telecom pulse compliance testing software (requires Opt. MTM on DPO7000 Series).

J2 – TDSDDM2 disk drive analysis software.

1P – Thermal printer.

[*2] DPO7254 or DPO7354 only.

[*3] DPO7054 and DPO7104 only.

[*4] Requires Ethernet Test Fixture.

[*5] Requires TDSUSBF (USB Test Fixture).

[*6] DPO7354 only.

[*7] Probe requires TPA-BNC adapter.

[*8] Requires Opt. MTM.

Digital Phosphor Oscilloscopes

▶ DPO7000 Series

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www.tektronix.com

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1/07 DV/WOW 4MW-19046-4

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